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ABSTRACT

High technology has begun to dominate many aspects of life, and educators face the difficult challenge of its integration into curriculum and instructional practices. Computer based instruction (CBI) is becoming an increasingly popular form of instruction. Educators are often reluctant, however, to incorporate CBI into their courses due to limited exposure and knowledge of its utilization. The Instructional Computing Module (ICM) for developing and/or purchasing computer courseware is designed to facilitate the development of CBI for instructional use. ICM entails eight steps (stimulus, recall, objectives, set induction, conceptual development, application, assessment, and reinforcement) which are segmented into three parts: the introduction, tutorial, and follow-up. Subjects included within the ICM framework are: characteristics of traditional methods vs. computer-assisted instruction; traditional courseware vs. an instructional computing module; and an evaluation guide for courseware selection and development. (JMK)

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"Peril or Promise of Computer-Based Education: The Conceptual Framework for Evaluation and Selection of Educational Software"

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High technology dominates many aspects of life today. Without it much of the future would be in peril and without promise. Educators face the complex challenge of its integration into curriculum and instructional practices. Computer-assisted instruction is becoming an increasingly popular form of instruction for classroom use. While educators are quick to acknowledge its importance, they are reluctant to implement it into their own instructional practices. The reasons range from limited exposure and/or staff training with non-traditional teaching methods to lack of success with implementation of computer assisted instruction (CAI). Educators need to resolve their prejudices, ~~and~~ differences, and involve themselves with the development and utilization of CAI in their instructional practices.

The purpose of this paper will be to present an Instructional Computing Module (ICM) for developing and/or purchasing computer courseware. Within the ICM framework will be presented the characteristics of traditional methods vs computer-assisted instruction, traditional courseware vs an instructional computing module, and an evaluation guide for courseware selection and development.

Traditional vs Computer-Assisted Instruction

Computer-assisted instruction has the potential to make radical changes in the way students learn. When CAI is compared with traditional approaches its impact in the classroom becomes more clearly defined.

Instruction in the traditional sense is teacher directed and group oriented. A singular format such as lecture usually prevails. Content is presented sequentially. Feedback is delayed and oriented to recording student progress. Moreover, there are access restrictions with regard to use of instructional materials and related resources. In contrast, CAI is learner centered. Not only can the student self select, but he can establish his own rate and pace of learning. Instruction is provided through multiple formats such as tutorial, simulation, modeling, drill and practice, or games. Instruction proceeds sequentially, but also it has branching and switching capabilities. Feedback is immediate and designed to instruct as well as reinforce prior learning. Recordkeeping consists of data on student performance as well as progress. Due to access to numerous data banks and increasing data storage capabilities, there are many resources available to enhance student learning.

Aside from these instructional aspects, the student in traditional or CAI setting has very different choices. In a traditional setting, the student has minimal involvement with learning. He tends to be passive, restricted to a designated

pathway of instruction and subject to limited choices. Learning occurs in a group setting. Consequently, the student has to learn at the same rate and pace as his peers. Competition is from other students. In a CAI setting, the student is an active learner. He no longer learns in the context of a group but progresses at his own rate. He has available more learning options and can direct his own progress. Competition with peers becomes almost non-existent in this context.

In conclusion, CAI holds a great deal of promise for improving classroom instruction. While change is never easy to accommodate, educators need to take advantage of benefits of CAI offered to them.

Instructional Computing Module (ICM) vs Traditional Courseware Design

Educators are familiar with instructional strategies for delivering stand-up instruction, but lack the background in designing strategies for implementing computer assisted instruction. The primary difference in a CAI approach to learning is that your audience is not "live." Therefore, an interative Socratic method is the key to effective instructional design. A preliminary analysis of the content and the learner guides the courseware designer in developing necessary interactive instructional strategies. Then, a CAI mode is selected and the instructional design process begins.

Traditional courseware is usually serialistic, and primarily a drill and practice routine. Generally, it consists of questions, a response mode, and feedback. Some traditional modules include a criterion reference test. If the lesson is linear the learner moves to the next module after completing the drills; if the lesson is nonlinear some provisions are made for branching. (Figure 1)

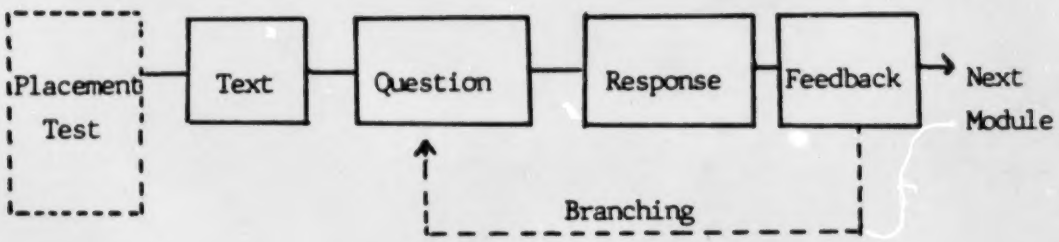


Figure 1. Traditional Computing Module

On the other hand, the Instructional Computing Module (ICM) is wholistic and considers drill and practice as a supplemental segment within the module. An extension of the traditional computer module is necessary to create a wholistic learning experience. As shown in Figure 2, an introductory segment at the "top" of the module presents enabling activities prior to the actual lesson. For example, if the lesson topic is map reading, a preliminary review of situations which necessitate the use of maps would be presented to the learner. At that time the differences in maps, usefulness of maps, and real life experiences with road maps would be addressed to assist the learner in focusing attention,

enhancing background, and conceptual development. Because the interpretation of maps requires spatial orientation and code translation, a prerequisite skill review should be available for those learners who need to reflect upon prior learning in mapping.

Another difference in the ICM from traditional courseware modules is the follow-up segment at the "bottom" of the lesson which includes the application, assessment and reinforcement steps (Figure 2). In the application step as illustrated in Figure 2, learners can experience a sense of independence because it divorces the learners from the instructional lesson and allows the learner to "try out" the concepts taught in the lesson. In the map reading example, the learner could be given a hypothetical situation whereby the problem solution necessitates interpreting a road map. For the learners who are not successful with the application step, they are branched into the reinforcement step which provides drill and practice.

Another difference in the ICM besides the introductory and follow-up segments is the assessment component. At the beginning of the lesson pre-assessment or criterion questions are presented within the recall step. The assessment results determine the learners progression through the lesson. At the end of the lesson a post-assessment or criterion questions are presented after the application segment. If the test criterion is mastered, learners progress to the next

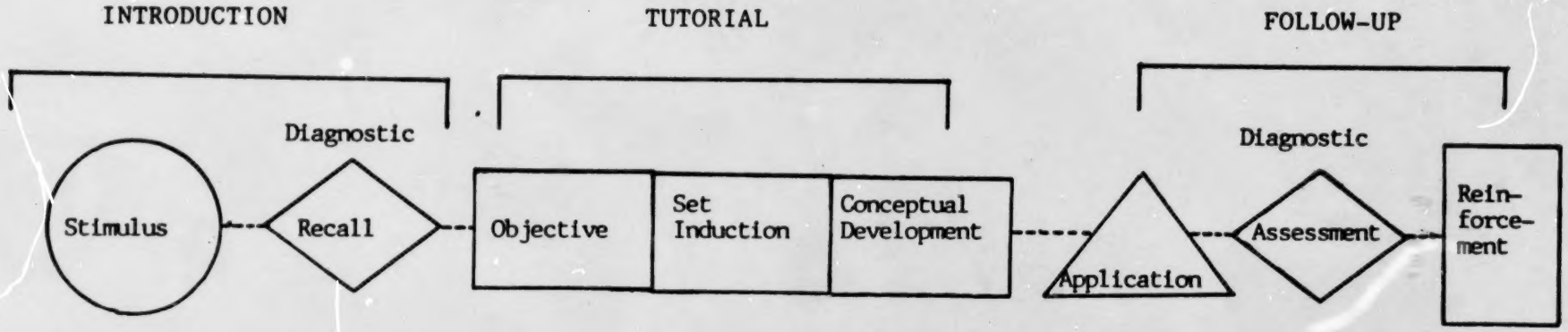


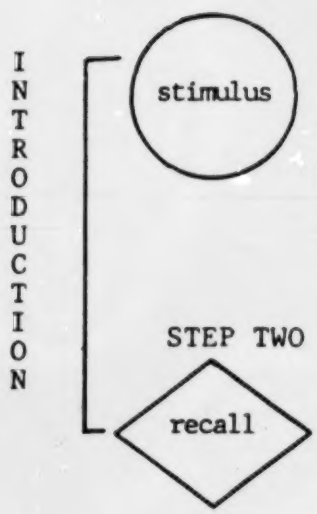
FIGURE 2. INSTRUCTIONAL COMPUTING MODULE

module; if the test criterion is not mastered several options are available: branching to the recall step, branching to the reinforcement step; or branching to the tutorial segment.

Instructional Computing Module (ICM)

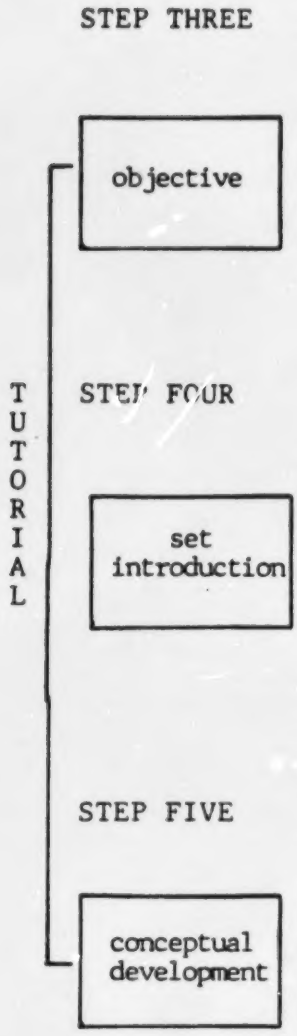
The eight steps of the ICM are described and illustrated below.

STEP ONE



The stimulus step introduces the learner to the content of the lesson through situational anecdotes (scenarios, case studies, problem solving). The intent is to immerse the learner into the content through the real and familiar.

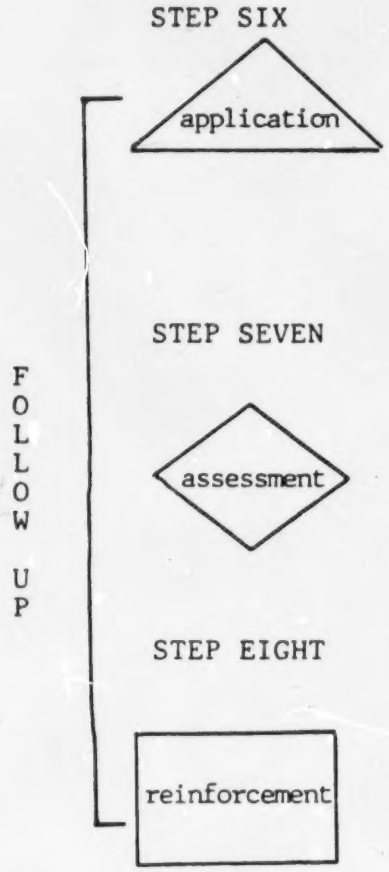
The recall step provides a review and criterion reference questions to determine the stream of instruction for the learner.



The tutorial segment of the lesson is introduced through behavioral objective(s) which are presented in a meaningful context...you will learn to read a road map to plan a trip across the country.

The set induction establishes a mind set or context for the lesson. It is distinguished from the introductory segments because it focuses directly on the content of the lesson, whereas the stimulus and recall steps focus upon generalized concepts.

Conceptual development is the nucleus of the lesson. The instruction is presented through text, interactive questions, and instructionally related feedback. If the introductory segment is motivational, informative, and task analyzed the learner should be prepared for this step in the module.



Application allows the learner to apply the subject matter concepts presented in the lesson to a new situation. It is an indication of mastery and transfer of learning.

A post test determines levels of subject mastery. If mastery is not obtained, learners branch to the recall, tutorial, or reinforcement steps.

Drill and practice activities are provided in this step. It should be fast moving and motivational. Often this step is the major instructional program with computer assisted instruction. The ICM considers the segment as a supplement to the lesson.

Theory of Learning As Basis for the ICM

The Instructional Computing Module incorporates the learning principles found in Gagnés (1981) learning theory model which he refers to as "events of instruction." The

major emphasis within Gagnés learning theory is the idea of shaping behavior through prerequisite skill development and learning hierarchies which evolve from low order to higher order instructional events. The theory focuses upon the internal and external conditions of learning. The "external" conditions refer to the events of instruction, and the "internal" conditions refer to learning behaviors enhanced through the events of instruction.

In the ICM (Figure 3) the external learning conditions are the eight instructional steps--stimulus, recall, objectives, set induction, conceptual development, application, assessment and reinforcement. The internal conditions are the parallel learning behaviors which correspond to the eight instructional steps.

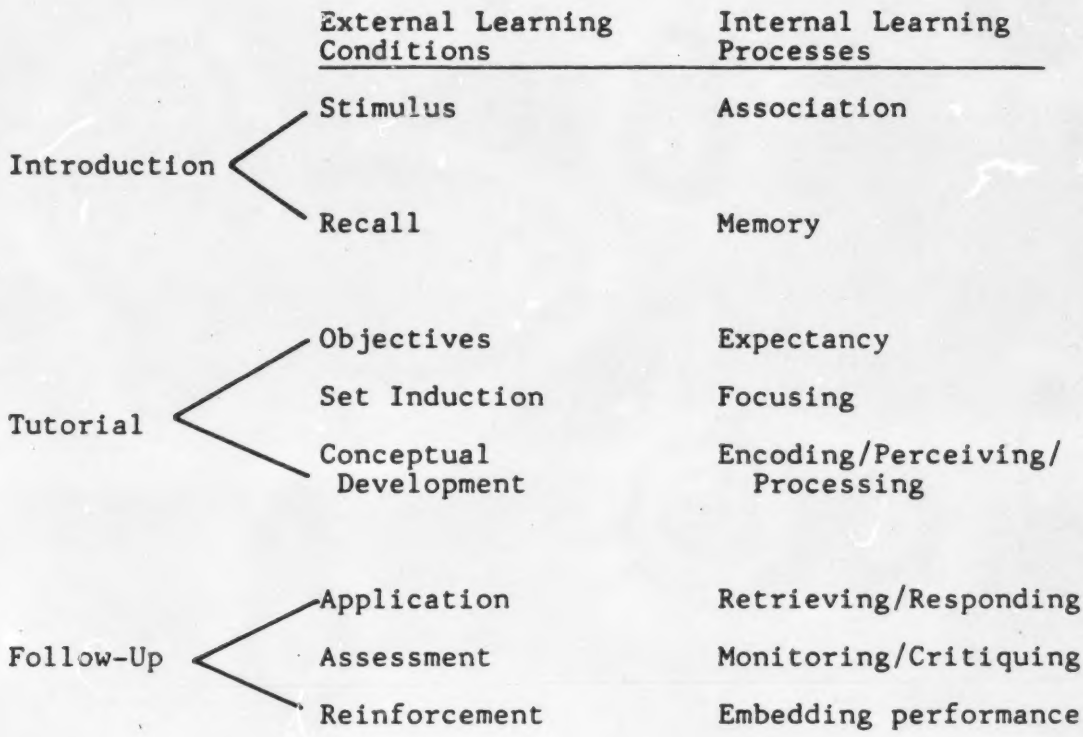


FIGURE 3. External and Internal Features of the Instructional Computing Modules

Current evaluation instruments usually analyze the macrostructure of computer courseware--subject matter content, instructional approaches, and technical production. For example, the Northwest Regional Laboratory's evaluation guide measures three categories: content, instructional quality, and technical quality. The ICM Evaluation Guide is unique because it focuses upon the microstructure rather than the macrostructure of computer courseware. Its purpose is twofold: (1) to evaluate the external conditions of learning and their corresponding internal learning processes, and (2) to identify instructional strategies for implementing each of the ICM steps. The first column of the ICM Evaluation Guide, as shown in Figure 4, presents a critical question related to each step in the module. The second column identifies the learning processes which are embedded within each ICM step. The third column includes specific instructional strategies which incorporate the principles of learning associated with each step of the module. For example, in the stimulus step webbing and advanced organizers prepare and motivate the learner for the lesson. Through associative learning

INTRODUCTORY SEGMENT

	External Learning Conditions	Internal Learning Processes	Implementation Strategies
S T I M U L U S	1._____ Does the module relate concepts, knowledge or interest to the topic presented in the module?	Association	. Advanced Organizers . Graphic Overviews . Webbing . Learning Hierarchies . Scenarios
R E C A L L	2._____Are there provisions for review and diagnosis before entering the module?	Memory	. Diagnostic Screening . Cognitive Style Mapping . Criterion Reference Testing

FIGURE 4. ICM EVALUATION GUIDE

TUTORIAL SEGMENT

	External Learning Conditions	Internal Learning Processes	Implementation Strategies
OBJECTIVE	3. _____ Are the objectives stated in operational terms?	Expectency	. State the objective in behavioral terms; i.e., explain, trace, compare.
	_____ Are the objectives clearly stated?		. State the objective in a contextual situation as an incentive or challenge.
SET INDUCTION	4. _____ Does the module guide the learner into the lesson through focusing techniques?	Focusing/Gaining Attention	. Cueing Strategies . Subordinating . Abstracting . Indexing . Humor . Tapping prior knowledge
CONCEPTUAL DEVELOPMENT	5. _____ Does the lesson progress from....	Perceiving/Encoding/ Processing	. Multisensory approaches (tactile, aural, visual)
	_____ simple to complex?		. Hierarchial questioning
	_____ concrete to abstract?		. Realea
	_____ explicit to implicit?		. Graphic impressions . Macrostructures

FOLLOW-UP SEGMENT

	External Learning Conditions	Internal Learning Conditions	Implementation Strategies
APPLICATION	6. _____ Are there provisions for transfer of concepts to a new situation?	Retrieving/Responding	. Hypothetical problem solving . Construction or assembly . Conditional assertions . Simulation
ASSESSMENT	7. _____ If objective is mastered, does the module provide the learner with options for the next module? _____ If objective is not mastered, is branching to a review, instructional, or reinforcement segment provided for the learner?	Monitoring/Critiquing	. Progress reports . Summaries . Transitions . Motivational responses and evaluations . Positive reinforcement
REINFORCEMENT	8. _____ Are there provisions for drill and practice exercises within the module?	Embedding performance	. Prerequisite skill development . Gaming . Chunking . Reducing . Structured overviews

techniques, the overviews can provide the learner with a wholistic view of the module objective. Or, in step four, set induction, focusing strategies, such as cueing, abstracting, and indexing are identified to demonstrate instructional techniques which guide the learner through the module via attention-getting and highlighting strategies.

The ICM micro evaluation guide should be used conjunctively with macro structure measures in order to equate the psychoeducational state of the learner with the content, production, and instructional quality of the computer courseware.

Summary

CAI holds a great deal of promise for affecting positive change in instructional practices. Educators need to take the leadership and develop its potential. This calls for careful assessment of instructional needs as well as the utilization of sound principles of learning in the design and/or selection of CAI. The Instructional Computer Module (ICM) is designed to facilitate the development of CAI for instructional use. ICM entails eight steps which are segmented into three parts: introduction, tutorial, and follow-up. The tutorial segment probably represents more traditional courseware. The introductory and follow-up segments of the ICM are added to the top and bottom of the tutorial. The introduction segment enhances memory and associative

principles of learning to prepare the learner for the tutorial segment. The follow-up segment is intended to verify mastery of objectives by applying concepts presented in the tutorial segment to a new situation, monitoring progress through reports and summaries, and embedding performance through drill and practice if the objective is not mastered.

Although the eight steps may not be appropriate for all content fields or audiences, the underlying theory of holistic, meaningful, and associative learning should be considered in the design or selection of computer courseware.

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